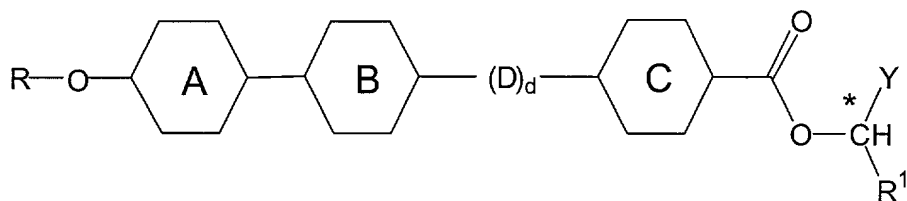


We claim:

1. A liquid crystal compositions which comprises one or more compounds of the formula:



wherein:

R is a linear or branched perfluorinated or partially fluorinated alkyl group (R^F), a linear, cyclic or branched perfluorinated or partially fluorinated ether group or a linear or branched ether group;

Rings A, B and C are 5- or 6-carbon aromatic rings each optionally substituted with from one to four fluorines and wherein one or two CH groups in the rings can be substituted with a N, an O or a S group;

d is 0 or 1;

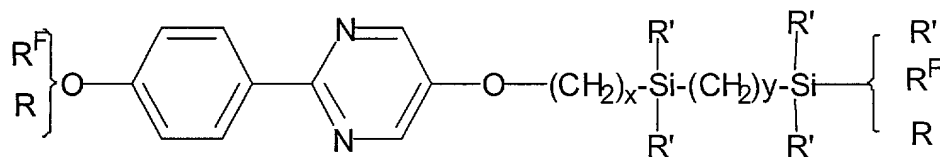
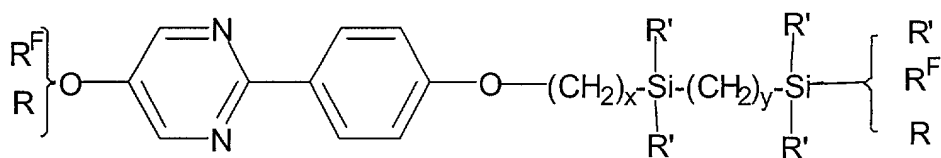
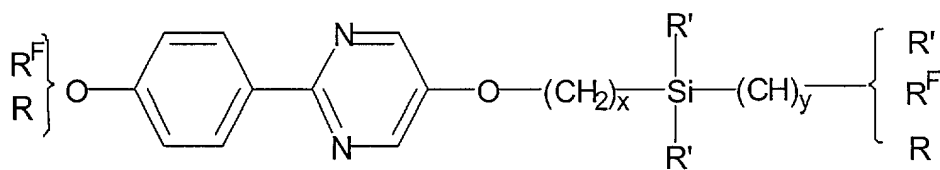
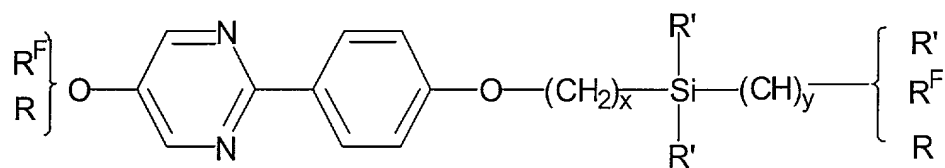
D is a linker group selected from the group consisting of -COO-, -OOC-, -CH₂-CH₂-, a cis or trans double bond, or a triple bond, when d is 0 rings B and C are linked through a single bond;

Y is an alkyl or fluorinated alkyl group having from one to six carbon atoms; and

R¹ is a nonchiral tail group selected from linear or branched alkyl groups where one or more non-neighboring CH₂ groups can be replaced with an -O-, -S-, -Si(R')₂-, -Si(R')₂-(CH₂)_p-Si(R')₂-, where p is an integer ranging from 1 to 6, -Si(R')₂-O-, -Si(R')₂-O-Si(R')₂-O-, a cis or trans double bond or a triple bond, wherein each R', independent of other R', is an alkyl or fluorinated alkyl group having from one to six carbon atoms and wherein the R¹ tail group is optionally substituted with one or more fluorines.

2. The liquid crystal composition of claim 1 which exhibits a de Vries smectic A phase.
3. The liquid crystal composition of claim 1 which exhibits V-shaped switching when incorporated as aligned layer in an analog liquid crystal device.
4. The liquid crystal composition of claim 1 wherein the core rings A, B and C are selected from the group consisting of phenyls, fluorine-substituted phenyls, pyridines and pyrimidines.
5. The liquid crystal composition of claim 4 wherein d is 1 and D is -COO- or -OOC-.
6. The liquid crystal composition of claim 5 wherein Y is an alkyl or perfluorinated alkyl group having 1 to 3 carbon atoms.
7. The liquid crystal composition of claim 6 wherein R is an ether, a partially fluorinated ether or a perfluorinated ether.
8. The liquid crystal composition of claim 6 wherein R is R^F .
9. The liquid crystal composition of claim 8 wherein R^F has the formula: $C_nF_{2n+1}C_mH_{2m}$ -wherein n is an integer ranging from 1 to about 10 and m is an integer ranging from 1 to about 10.
10. The liquid crystal composition of claim 8 wherein R^F has the formula: $C_nF_{2n+1}C_mH_{2m}$ wherein n is an integer ranging from 1 to about 20 and m is an integer ranging from 0 to about 10.
11. The liquid crystal composition of claim 1 wherein d is 1 and D is -CH₂-CH₂-.

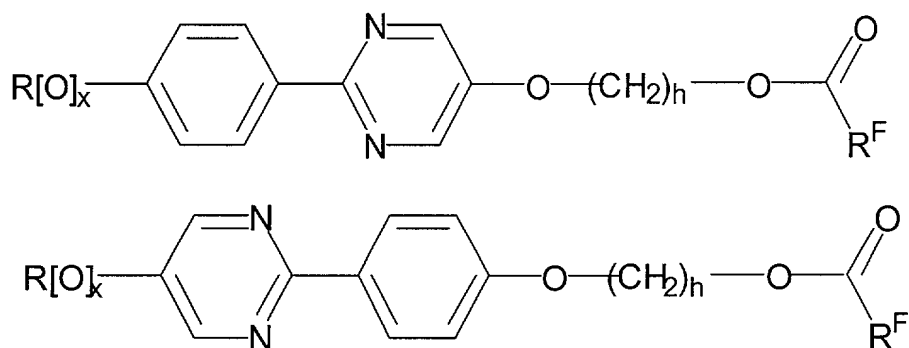
12. The liquid crystal composition of claim 1 further comprising one or more components having any of the formulas:



where x and y, independent of x and y in other components, are integers ranging from 1 to 10 inclusive; R' is a lower alkyl group having from 1 to 6 carbon atoms; R is an achiral or racemic alkyl group having from 3 to 20 carbon atoms, R^F is a perfluorinated alkyl group or partially fluorinated group having 1 to 20 carbon atoms.

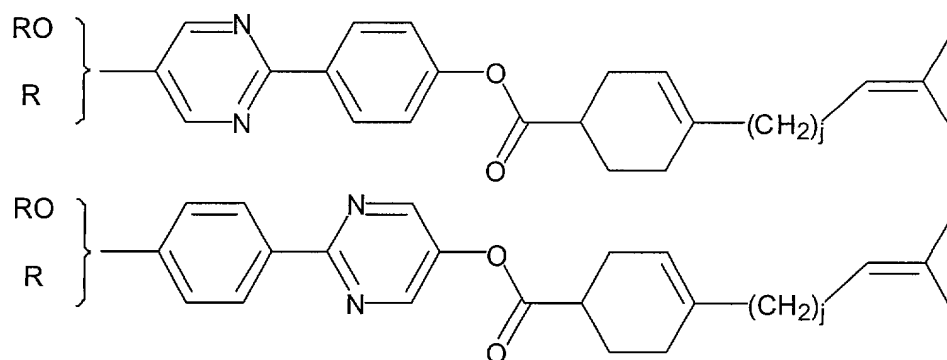
13. The mixture of claim 12 wherein the one or more components of the listed formulas are present in a total amount of about 25% by weight or more of the mixture.

14. The liquid crystal composition of claim 12 further comprising one or more components having the formulas:



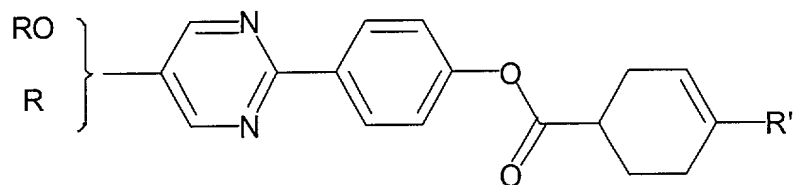
where x is 0 or 1, independent of x in other components, h is an integer from 1 to 10, R is an alkyl group having from 3 to about 20 carbon atoms, R^F is a perfluorinated alkyl group or partially fluorinated group having 1 to 20 carbon atoms.

15. The liquid crystal composition of claim 12 further comprising one or more components having the formulas:



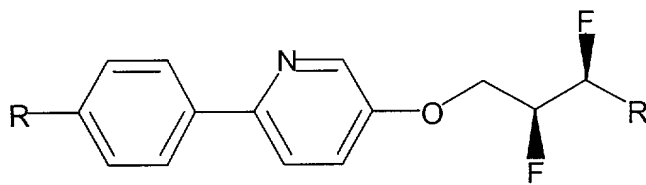
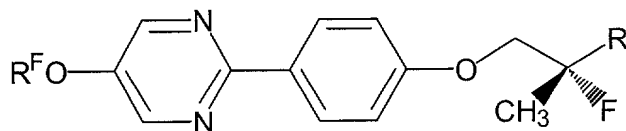
where j is an integer that ranges from 2 to 10, inclusive, and R is an alkyl group having from 3 to 20 carbon atoms.

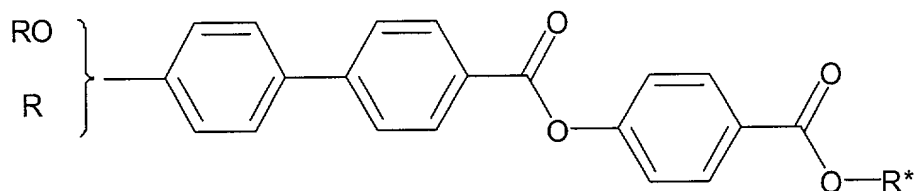
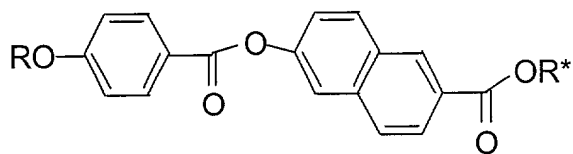
16. The liquid crystal composition of claim 15 further comprising one or more components having the formula:



wherein R' is a lower alkyl group having from 1 to 6 carbon atoms.

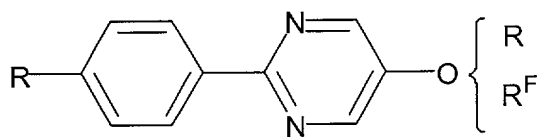
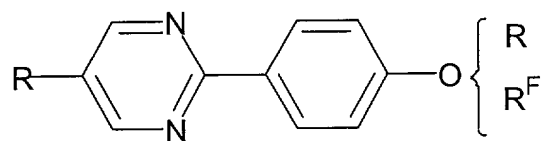
17. The liquid crystal composition of claim 12 which has a total number of components of 5 or more.
18. The liquid crystal composition of claim 1 which comprises a first chiral nonracemic component which comprises one or more chiral nonracemic compounds of the formula.
19. The liquid crystal composition of claim 16 further comprising a second chiral nonracemic component which comprises one or more chiral nonracemic compounds selected from the group of compounds having formulas:

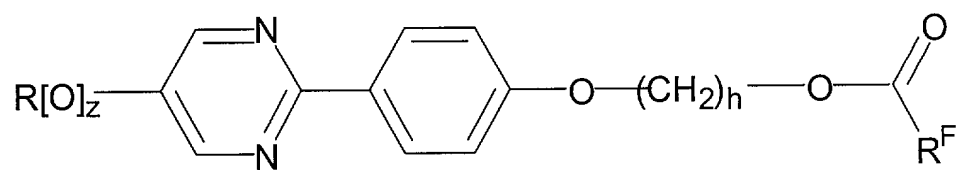
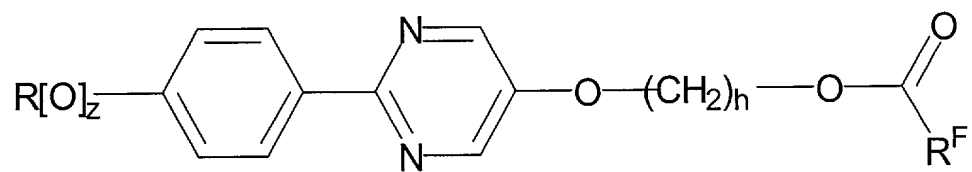
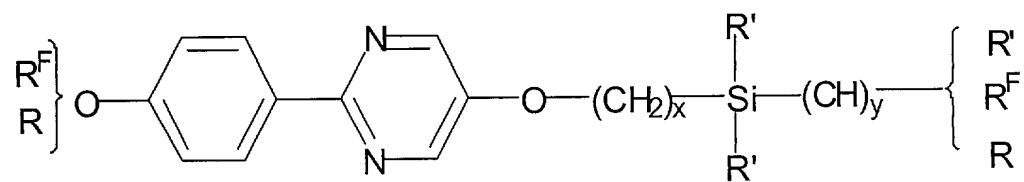
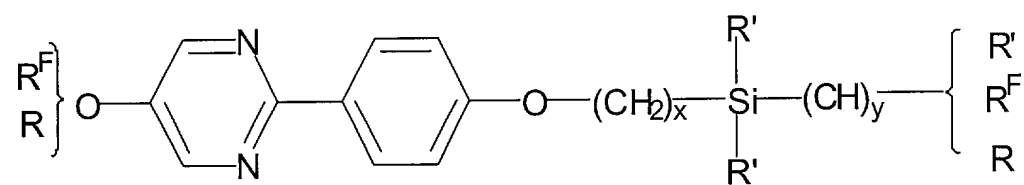
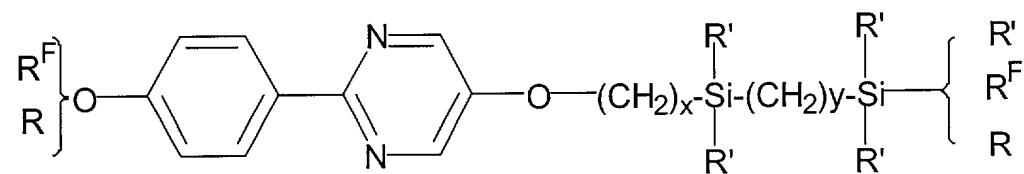
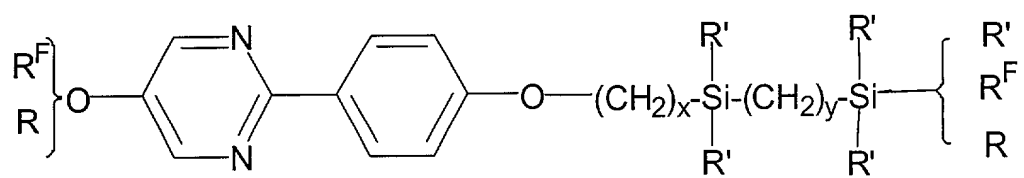


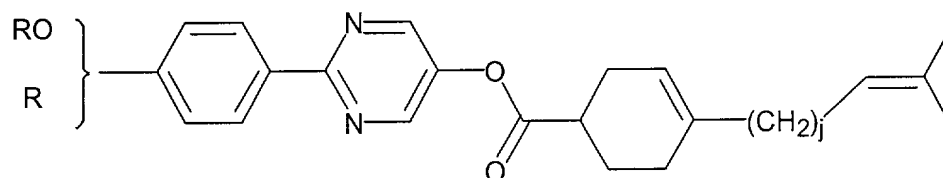
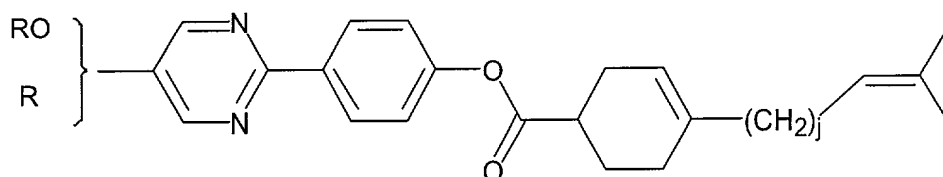
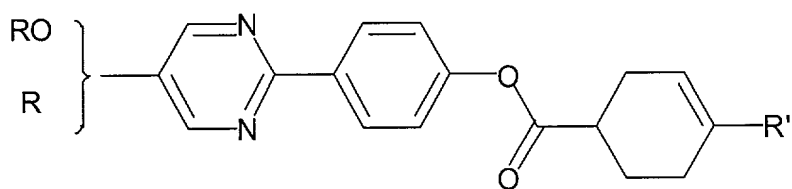


or enantiomers thereof where R is an alkyl group having from 2 to about 20 carbon atoms, R* is a chiral nonracemic branched alkyl group having from 3 to about 20 carbon atoms, and R^F is a perfluoroalkyl or a partially fluorinated alkyl groups having from 3 to about 20 carbon atoms.

20. The liquid crystal composition of claim 19 wherein the second chiral nonracemic component is present in the mixture at a level of at least about 10% by weight.
21. The liquid crystal composition of claim 19 further comprising an achiral or racemic component which comprises one or more compounds having the formulas







z is 1 or 0, x and y, independent of x and y in other components range from 1 to 20, h is an integer ranging from 1-10, j is an integer ranging from 2-20,

R is an alkyl group (linear or branched) having from 3 to 20 carbon atoms;

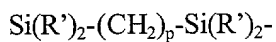
R^F is a partially fluorinated or perfluorinated tail group and R' is a lower alkyl group having from 1 to 6 carbon atoms.

22. The liquid crystal composition of claim 21 which contains a total number of components of 5 or more.
23. The liquid crystal composition of claim 21 which contains at least one component of each formula listed.

- 5 24. The liquid crystal composition of claim 1 wherein R is R^F.

25. The liquid crystal composition of claim 24 wherein Y is an alkyl or fluorinated alkyl group having from 1 to 3 carbon atoms.
26. The liquid crystal composition of claim 25 wherein Y is CF₃.
27. The liquid crystal composition of claim 26 wherein R¹ is an alkyl group.
- 5 28. The liquid crystal composition of claim 27 wherein R¹ is an alkyl group having from 4 to 8 carbon atoms.
29. The liquid crystal composition of claim 26 wherein the rings A, B and C are phenyl rings or fluorine-substituted phenyl rings.
30. The liquid crystal composition of claim 29 wherein d is 1 and D is -COO- or -OOC-.
- 10 31. The liquid crystal composition of claim 26 wherein at least one of rings A, B or C is a pyridine or a pyrimidine ring.
32. The liquid crystal composition of claim 31 wherein d is 1 and D is -COO- or -OOC-.
33. The liquid crystal composition of claim 26 wherein R¹ contains one or more Si atoms.
34. The liquid crystal composition of claim 33 wherein R¹ has the formula:

15



where p is 1-6 and R' is a small alkyl group having from 1 to 3 carbon atoms.

35. The liquid crystal composition of claim 33 wherein:

R^1 contains a $-\text{Si}(\text{R}')_2-\text{CH}_2-\text{Si}(\text{R}')_2-$ group

where R' is a small alkyl group having from 1 to 3 carbon atoms.

36. The liquid crystal composition of claim 33 wherein:

5 R^1 contains a $-\text{Si}(\text{R}')_2-\text{O}-$ group

where R' is a small alkyl group having from 1 to 3 carbon atoms.

37. The liquid crystal composition of claim 33 wherein:

R_1 contains a $-\text{Si}(\text{R}')_2-\text{O}-\text{Si}(\text{R}')_2-$ group

where R' is a small alkyl group having from 1 to 3 carbon atoms.

10 38. The liquid crystal composition of claim 1 wherein Y is CF_3 .

39. The liquid crystal composition of claim 38 wherein R^1 is an alkyl group.

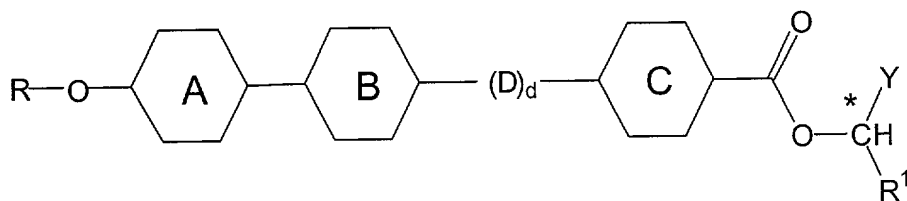
40. The liquid crystal composition of claim 38 wherein R^1 contains a PDMS group.

41. The liquid crystal composition of claim 40 wherein rings A, B and C are phenyl rings or fluorine-substituted phenyl rings.

15 42. The liquid crystal composition of claim 40 wherein R is R^F .

43. The liquid crystal composition of claim 1 wherein R is an ether having the formula $C_qH_{2q+1}-O-C_rH_{2r}-$, where q and r are integers from 1 to 20.
44. The liquid crystal composition of claim 43 wherein Y is CF_3 .
45. The liquid crystal composition of claim 44 wherein R^1 is an alkyl group.
- 5 46. The liquid crystal composition of claim 45 wherein rings A, B and C are selected from the group consisting of phenyls, fluorine-substituted phenyls, pyridines and pyrimidines.
47. The liquid crystal composition of claim 46 wherein rings A, B and C are selected from the group consisting of phenyl rings, or fluorine-substituted phenyl rings.
- 10 48. The liquid crystal composition of claim 1 wherein R is an ether having the formula: $C_qH_{2q+1}-O-C_rH_{2r}-O-C_sH_{2s}-$, where q, r and s are integers from 1 to 20.
49. The liquid crystal composition of claim 1 which exhibits a Ps of 27 nC/cm² or greater.
50. The liquid crystal composition of claim 1 which exhibits a Ps of 40 nC/cm² or greater.
51. The liquid crystal composition of claim 1 which when introduced as an aligned layer in a liquid crystal device exhibits an electric rise time of 150 μ sec or less.
- 15 52. The liquid crystal composition of claim 1 which exhibits viscosity of 200 mP*S or less.
53. The liquid crystal composition of claim 1 which exhibits a smectic A phase which extends over a range of 20°C or more.

54. The liquid crystal composition of claim 1 which exhibits both a smectic A and a smectic C phase.
55. The liquid crystal composition of claim 54 which exhibits a smectic C phase with a temperature range encompassing room temperature.
56. A compound having the formula:



wherein:

R is a linear or branched perfluorinated or partially fluorinated alkyl group (R^F), a linear, cyclic or branched perfluorinated or partially fluorinated ether group or a linear or branched ether group;

Rings A, B and C are 5- or 6-carbon aromatic rings each optionally substituted with from one to four fluorines and wherein one or two CH groups in the rings can be substituted with a N, an O or a S group;

d is 0 or 1;

D is a linker group selected from the group consisting of -COO-, -OOC-, a cis or trans double bond, or a triple bond, when d is 0 rings B and C are linked through a single bond;

Y is an alkyl or fluorinated alkyl group having from one to six carbon atoms; and

R^1 is a nonchiral tail group selected from linear or branched alkyl groups where one or more non-neighboring CH_2 groups can be replaced with an -O-, -S-, $-Si(R')_2-$, $-Si(R')_2-(CH_2)_p-Si(R')_2-$, where p is an integer ranging from 1 to 6, $-Si(R')_2-O-$, -

Si(R')₂-O-Si(R')₂-O-, a cis or trans double bond or a triple bond, wherein each R', independent of other R', is an alkyl or fluorinated alkyl group having from one to six carbon atoms and wherein the R¹ tail group is optionally substituted with one or more fluorines.

- 5 57. The compound of claim 56 wherein Y is CF₃ and R is R^F.
58. The compound of claim 57 wherein R^F is a partially fluorinated tail
59. The compound of claim 58 wherein R^F has the formula C_nF_{2n+1}C_mH_{2m}-wherein n is an integer ranging from 1 to about 10 and m is an integer ranging from 1 to about 10.
60. The compound of claim 59 wherein R^F is C₄F₉C₄H₈-.
- 10 61. The compound of claim 59 wherein R^F is C₄F₉C₆H₁₂-.
62. The compound of claim 59 where rings A, B, and C are selected from the group consisting of phenyl groups and fluorine-substituted phenyl groups.
63. An electrooptical device comprising an aligned liquid crystal layer which comprises the liquid crystal composition of claim 1.
- 15 64. The electrooptical device of claim 63 wherein the device exhibits bistable switching.
65. The device of claim 64 which is an analog device exhibiting V-shaped switching.

66. An electrooptical device comprising an aligned layer which comprises the liquid crystal composition of claim 1 and which can be operated at low driving voltages at high frequency and using a symmetrical driving scheme for DC balance.

67. A method for making a bistable liquid crystal electrooptical device which comprises the step of aligning a liquid crystal composition of claim 1 which exhibits a de Vries smectic A phase in a bookshelf alignment in the device.

68. A method for making an electrooptical device that exhibits analog switching which comprises the step of aligning a liquid crystal composition of claim 1 which exhibits V-shaped switching in the device.

69. A method for making a liquid crystal composition which exhibits both bistable switching and V-shaped switching which comprises the step of combining one or more chiral nonracemic compounds of claim 1 with one or more liquid crystal compounds which have one or both tail groups that are partially fluorinated or that contain one or more Si atoms.

70. The method of claim 69 wherein about 25% to about 65% of a chiral nonracemic compound of claim 1 is combined to form the liquid crystal composition.